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Department of Energy

Ohio Field Office
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OCT 6 2004

DOE-0424-04

Mr. James A. Saric, Remedial Project Manager
United States Environmental Protection Agency
Region V, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF RESPONSES TO THE OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE 2003 SITE ENVIRONMENTAL REPORT

Enclosed for your review and approval are responses to the Ohio Environmental Protection Agency (OEPA) comments on the 2003 Site Environmental Report. The United States Environmental Protection Agency (USEPA) indicated to the Department of Energy in the August 31, 2004 weekly conference call that they would not be providing comments on this report.

If you have any questions or need further information, please contact Ed Skintik (513) 246-1369 or Johnny Reising at (513) 648-3139.

Sincerely,

Johnny Reising

for William J. Taylor
Director

FCP:Skintik

Enclosure: As Stated

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K. Voisard, Fluor Fernald, Inc./MS12
R. White, Fluor Fernald, Inc./MS52-5
ECDC, Fluor Fernald, Inc./MS52-7

RESPONSES TO
OHIO ENVIRONMENTAL PROTECTION AGENCY
COMMENTS ON THE
2003 SITE ENVIRONMENTAL REPORT

FERNALD CLOSURE PROJECT
FERNALD, OHIO

SEPTEMBER 2004

U.S. DEPARTMENT OF ENERGY

RESPONSES TO OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE 2003 SITE ENVIRONMENTAL REPORT (51350-RP-0024, REVISION 0 FINAL)

COMMENTS

1. Commenting Organization: Ohio EPA — Commenter: DSW
Section #: 4.3.1/SER — Pg #: 75 — Line #: Table 4-2 & Figure B.1-4 — Code: C
Original Comment #: 1
Comment: Table 4-2 lists the cross media impacts that exceed the groundwater FRL. Not included in this table is the sample that appears in Figure B.1-4 that exceeds 40 ppb total uranium. The data for 2003 posted on the Extranet shows a maximum total uranium concentration of 3.7 ppb for location SWP-03 for 2003, as does the text in Section 4.3.1, Page 74. Is Figure B.1-4 correct?
Response: SWP-03 is not a cross-media impact location; therefore, Table 4-2 should not include SWP-03 information. It should be noted that the 2003 data provided in Figure B.1-4 for SWP-03 were incorrect. The uranium results for 2003 at SWP-03 were 1.8, 2.1, 3.7, and 3.6 μg/L. The remainder of the figures in Appendix B.1 were checked for accuracy and it was found that only Figure B.1-4 was erroneous.
Action: DOE will make every attempt to ensure the accuracy of figures provided in the site environmental reports.

2. Commenting Organization: Ohio EPA — Commenter: GeoTrans, Inc.
Section #: A.4 — Pg #: A.4-3 — Line #: NA — Code: C
Original Comment #: 2
Comment: The text states that for two of the five wells with non-uranium FRL exceedances (2430 and 3067), a determination will be made as to whether additional wells will need to be installed. The repeated exceedances of manganese in 2430 are sufficient reason for considering a replacement well at this location. Why is 3067 also considered for replacement while the other three wells shown in the table are not?
Response: As stated on Page A.4-3, with the exception of Well 2430, none of the wells have had constituents with frequent exceedances. It is for that reason that replacements are not being considered at this time for these wells. It should be noted that a determination for the need to install replacement wells for IEMP Property Boundary Monitoring Wells 2430 and 3067 will be made following the completion of the installation of all needed OSDF Groundwater Monitoring Wells, which is anticipated to occur late in 2004 or early in 2005. The objective will be to use OSDF Groundwater Monitoring Wells for Property Boundary Monitoring also, when their locations facilitate and warrant their dual usage.
Action: As stated in the response.

3. Commenting Organization: Ohio EPA — Commenter: GeoTrans, Inc.
Section #: A.5 — Pg #: A.5-4 — Line #: 7 — Code: C
Original Comment #: 3
Comment: As stated in Section 3.2 of the Technical Memorandum: "it is necessary to have the baseline data in steady-state (i.e., does not exhibit statistically significant trends), be normally distributed, and exhibit statistical independence (i.e., no serial correlation detected) in order to standardize sample data and establish control limits." This statement echoes the guidance established in the environmental field for control chart analysis of intra-well groundwater monitoring data sets (U.S. Environmental Protection Agency, 1998 and 1993; American Society for Testing and Materials, 1999; Gibbons, R.D., 1994), which are typically characterized as highly skewed, non-normally distributed, and inclusive of a large percentage of non-detects (Helsel and Hersch, 1992). DOE should continue to use control charts to evaluate OSDF groundwater data only when appropriate (i.e., no trends or serial

correlation) in accordance with established environmental practices. References are available if requested.

Response: In the April 6, 2004 conference call and as documented in the May 3, 2004 letter (subject: April 6, 2004 Conference Call on the On-site Disposal Facility Data Evaluation and Reporting Path Forward), DOE identified that control charts would be prepared for all OSDF locations, regardless of serial correlation and trend. A write-up proposing this modification was provided as part of the March 23, 2004 weekly conference call information and discussed in the April 6 conference call. DOE identified that control charts would be prepared as a means of providing additional information in order to establish an evaluation protocol for leak detection monitoring data. DOE acknowledges the comment and will no longer prepare control charts for any location/constituent where trend and/or serial correlation are an issue. Additionally refer to Comment Response # 7, which pertains to control charts.

Action: Control charts will not be prepared for any location/constituent where trend and/or serial correlation are an issue. Additionally, refer to Action #7, which pertains to control charts.

4. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-5 Line #: 32 Code: C
Original Comment #: 4

Comment: To assess/verify the likelihood that the observed increasing concentrations observed in the horizontal till wells are the result of "aging water" phenomena, as discussed here in the text and more fully in the Technical Memorandum in Section 4.3, the ongoing baseline data collection activities at the site should be modified to include common ions (sodium, calcium, magnesium, manganese, potassium, iron, chloride, sulfate, phosphate, alkalinity, and pH). Significant upward trends in the common ions should also be observed in accordance with the "aging" process. It is postulated that this process is triggered by construction of the cell and the resultant elimination of a precipitation-derived recharge to the till.

Response: As the bulk of material in the cell is soil derived from the till, the major and minor ions in water will be similar for leachate developing in the cell and groundwater in the horizontal till wells. That is, carbonate minerals in the OSDF fill and in-place till control evolving water compositions in the same manner, which precludes the use of major and minor ions to map out the aging process. For example, calcium, magnesium, alkalinity and pH are not good indicators of the aging process because their concentrations will be controlled by the dissolution of calcite and dolomite grains as rainwater equilibrates with the carbonate till material that is present in the cell, liner, and horizontal till well zone. Steady-state concentrations for these parameters can be achieved in 30 to 60 days, which eliminates their use for monitoring upward trends of ions because leachate will have values similar to those in groundwater present in the horizontal till wells.

Sodium, potassium, manganese, iron, sulfate, chloride, and phosphate are also not good indicators because the ion concentrations in the leachate do not significantly exceed the baseline concentrations of the ions in the perched water from the horizontal till wells. For example, the background sulfate values are quite variable in the perched water (190 – 950 mg/L) and in horizontal till monitoring wells sampled prior to 1997 (over 1,000 mg/L), which precludes using sulfate as a good indicator because leachate sulfate values range from 1,260 to 3,020 mg/L. As the lower end of the sulfate range for leachate is essentially indistinguishable from the highest background values in the horizontal till wells, only the higher sulfate values in the leachate have a chance of being detected, and the high-sulfate leachate would have to comprise approximately 20 percent of the groundwater being sampled before sulfate reached a level that was significantly above 1,000 mg/L. Given the hydrology of groundwater flow in the till and the nature of the OSDF liner, it is unlikely that leachate will drip into the horizontal till wells at a rate sufficient to generate 20 percent of the horizontal till well water volume.

Uranium is a good indicator of the aging process because it is a trace element (above background but below soil final remediation level) in the till that will not reach a solubility limit when dissolved into solution and, when dissolved, it forms the mobile uranyl di- and tricarbonate anions, which are not readily sorbed to till minerals. Because uranium forms anionic complexes, the uranium concentration in groundwater will continue to increase after major ions have stabilized. The maximum observed uranium groundwater concentration in samples recovered from horizontal till wells in the OSDF footprint, prior to cell construction, is approximately 20 μg/L. Therefore, a fair assessment of groundwater aging can be made using monitoring results for uranium. As uranium concentrations build up to 20 μg/L, the water would be following a normal evolution path. If uranium levels begin to exceed 20 μg/L, it would be reasonable to assume leachate may be contributing to the uranium loading in the horizontal till well water.

Action: Uranium will continue to be monitored and the data will be reviewed as it is a good indicator of the aging process.

5. Commenting Organization: Ohio EPA — Commenter: GeoTrans, Inc.
Section #: A.5 — Pg #: A.5-6 — Line #: 20 — Code: C
Original Comment #: 5

Comment: It is agreed that a two-year cycle is appropriate for updating the control charts. Use of the two-year cycle, however, is inconsistent with Page C-8 of the Technical Memorandum, which states that a comparison of the baseline and post-baseline data sets will be conducted on an annual basis. Does the text indicate a formal change in how often the control charts will be updated?

Response: Updates to the OSDF leak detection reporting process have been evolving as additional data are collected (subsequent to the technical memorandum). Changes have been identified through the IEMP reporting process and weekly conference calls. Prior to site closure, the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan will be revised to identify reporting criteria.

Action: Prior to site closure, the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan will be revised to identify reporting criteria.

6. Commenting Organization: Ohio EPA — Commenter: GeoTrans, Inc.
Section #: A.5 — Pg #: A.5-7 — Line #: 1 — Code: C
Original Comment #: 6

Comment: The control charts show that a high rate of control limit exceedance occurred for the constituent/monitoring point combinations that had exhibited trend and/or serial correlation during baseline relative to those that did not. The exceedance rate for the monitoring point/constituent combinations with trend and/or serial correlation was 27 percent while the rate for the other combinations was nine percent. It appears, therefore, that the false positive rate may be adversely impacted by ignoring baseline data trends and serial correlation.

Response: Refer to Comment Response #3. Control charts will not be prepared for any location/constituent where trend and/or serial correlation are an issue. Additionally, refer to Comment Response # 7, which pertains to control charts.

Action: Control charts will not be prepared for any location/constituent where trend and/or serial correlation are an issue. Additionally, refer to Comment Response # 7, which pertains to control charts.

7. Commenting Organization: Ohio EPA — Commenter: GeoTrans, Inc.
Section #: A.5 — Pg #: A.5-7 — Line #: 1 — Code: C
Original Comment #: 7

Comment: Fifteen percent of the control chart limits were exceeded in 2003. DOE minimizes the significance of the exceedances in the text discussions by suggesting that they are the result of groundwater aging or pre-existing contamination. The respective FRLs for the monitored constituents are used in the text as proxies for comparison to the data. While pre-existing contamination and groundwater aging are possible explanations for the control limit exceedances, a more appropriate limit should be used in the interim period while better estimates of baseline data parameters are obtained. Use of a percentage of the FRL (75 percent, for example) in the horizontal till wells would allow the early identification of a leak detection issue before a greater-than-FRL release to the environment occurs.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations. The commentor suggests that baseline conditions may not be fully bracketed at all locations at this time and DOE agrees with this conclusion.

Many of the data collected subsequent to those used to establish "baseline" in the Technical Memorandum for Cells 1, 2, and 3 indicate the conditions in many of the locations being monitored have not reached a steady state, which is needed to define baseline. Further, the known, above background but below FRL pre-existing contamination levels in the glacial overburden and in the underlying Great Miami Aquifer, complicate leak detection determinations as DOE has indicated since before OSDF construction began. That is why DOE, in conjunction with EPA and Ohio EPA, has developed a leak detection program that not only involves sampling and analysis of chemical indicators but the tracking and evaluation of the flow volumes yielded from the LCS, LDS, and horizontal till wells. It was this overall data set (chemical data and flow volume data) that DOE used to conclude that there was no cause for concern at this time.

As the commentor suggests, use of a percentage of the FRL as an early warning that action may be needed is probably more appropriate until such a time that baseline can truly be established. However, flow information must always be factored into the overall leak detection evaluation process, as well. For example, groundwater modeling was performed using the 2004 flow and uranium concentration data from the Cell 3 LCS. In this modeling, DOE conservatively assumed that all the flow from the Cell 3 LCS (average of 311 gallons per day for the first six months of 2004) directly leaked into the GMA. Cell 3 was picked for this modeling exercise because it has the highest LCS flow rate and uranium concentration of the three cells that are completely filled.

The large VAM3D model (120 x 112 x 12) was run with a single source term at the approximate water table (model layer 3 which approximates model layer 12 in the zoom model) corresponding to a hypothetical leak in the liner penetration box beneath Cell 3.

Source term strength was calculated from the Cell 3 LCS flow information noted above and the maximum monthly average leachate total uranium concentration recorded for the first half of 2004 (February 2004 @ 71 μg/L). Thus, a flow rate of 0.216 gpm (42 cubic ft/day) at a concentration of 71 μg/L (4.43 x 10^3 nano-lbs/cubic ft) was used for the source term.

A no-pumping scenario (including no pumping from the Southwest Ohio water collection wells) was used with dry (October 1999) boundary conditions and run for 10 years. This is anticipated to give the maximum concentration since the aquifer would have minimum flow under these conditions.

A Kd of 1.78 L/Kg was used since a file for the large model with Kd = 3 L/Kg was not readily available. Given the extremely low concentrations in the aquifer, Kd shouldn't make an appreciable difference in the results. As shown in the attached figure, the results of this modeling indicates that after 10 years of direct leakage to the aquifer, maximum uranium concentrations in the aquifer as a result of the leak would be about 0.04 μg/L. This concentration would be undetectable in the OSDF Great Miami Aquifer monitoring wells given the current "background" levels of uranium in the aquifer beneath the OSDF.

The commentor is also referred to the Operable Unit 5 Feasibility Study, Appendix F for additional discussion on the conservative methodology that was used to develop the Waste Acceptance Criteria for the OSDF so that the OSDF would remain protective of the environment.

Action: Per the recommendation in the comment, for those constituents with FRLs, DOE will use 75 percent of the FRL value as a "more appropriate" limit in the interim while better estimates of baseline data parameters are obtained. The limits based on FRLs will be used in conjunction with LCS/LDS flow volume information to allow for identification of a leak detection issues and in future reporting on OSDF Leak detection monitoring program, more emphasis will be placed flow volume yielded from the LCS/LDS. For those constituents without FRLs (e.g., total organic carbon), concentration versus time plots will continue to be used along with trend analysis. Therefore, control chart methodology will not be used while better estimates of baseline data are obtained. Additionally, based on modeling information obtained through this exercise, DOE recommends that further discussion with OEPA and EPA be conducted regarding further refinement of the OSDF monitoring program.

8. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-7 Line #: 20 Code: C
Original Comment #: 8

Comment: In discussing control chart results, the maximum concentrations reported should be taken from the post-baseline period. Maximums from the baseline interval are not relevant to leak detection analysis beyond the establishment of the control limits.

Response: DOE acknowledges the comment. As indicated on line 10 of page A.5-7, text pertains to charts/plots in Attachments A.5.1 (control charts) and A.5.2 (concentrations versus time plots). The maximums identified in Attachment A.5.1 (control charts) are post-baseline maximums. The text on page A.5-7 refers to the overall maximum concentrations provided in Attachment A.5.2. In the future, DOE will clearly identify what type of maximum concentration is referred to in the text.

Action: In the future, DOE will clearly identify what type of maximum concentration is referred to in the text.

9. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-7 Line #: 23 Code: C
Original Comment #: 9

Comment: The occurrence of a downward trend in the LCS and a flat trend in the LDS do not necessarily exclude the potential that a leak exists. The decline may have resulted from dilution in the LDS downstream from a possible leak in the primary liner.

Response: DOE acknowledges the comment. The perched water infiltration/dilution scenario suggested by the commentor is possible. However, the drainage improvements on the west side of Cell 1 (completed in January – March 2004) may be helping to reduce the volume of water coming out of the Cell 1 LDS. The annual Cell 1 LDS volume for 2003 was 2,122 gallons while the volume in 2004 through June was only about 240 gallons.

Action: ~~In future site environmental reports, DOE will refrain from concluding that no trend in the~~ Cell 1 LDS confirms the integrity of the primary liner since perched water dilution is a factor that could potentially affect the Cell 1 LDS chemical concentrations.

10. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-7 Line #: 28 Code: C
Original Comment #: 10

Comment: An alternative interpretation of the data (Cell 1, total uranium) is that a leak concern is indicated because the concentrations decrease from LCS (55.5 μg/L) to LDS (13 μg/L) to

HTW (4.2 µg/L), the HTW cusum shows a strong upward trend, and the HTW standardized mean exceeds its control limit.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. As noted in the Comment Response #7, DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations.

Action: Refer to Action #7.

11. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-7 Line #: 28 Code: C
Original Comment #: 11

Comment: The text suggests pre-existing contamination as possible explanation for the elevated concentrations in the HTW. Although the pre-existing contamination explanation is plausible for the GMA (regional flow patterns and high groundwater velocities could move contamination into the area and cause post baseline trends), it is tenuous for the till. Any pre-existing contamination would likely have been accounted for in the baseline data set and reflected in the control limits.

Response: DOE disagrees that the pre-existing contamination was fully accounted for in the baseline data set. As noted in the annual site environmental reports and in the Technical Memorandum for Cells 1, 2, and 3 placement of the cells over the areas being monitored by the horizontal till wells resulted in significant changes in the hydrogeologic environment, most notably the blockage of rainwater infiltration. The commentor is also referred to the OSDF Pre-Design data set where pre-OSDF uranium concentrations in the perched water beneath the cell 1 footprint ranged from < 1 µg/L to 21 µg/L. Refer to Comment Response #4.

Action: No action required.

12. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-7 Line #: 37 Code: C
Original Comment #: 12

Comment: A leak concern may exist (Cell 2, total uranium) based on the downward trend in the concentrations between the monitoring horizons. Concentrations decline from the LCS (maximum baseline is 68.6 µg/L) to the LDS (maximum baseline is 19.6 µg/L) to the HTW (maximum baseline is 7 µg/L), the HTW cusum shows a strong upward trend, and the standardized mean exceeds its control limit. Pre-existing till contamination is again offered as an explanation for the HTW control limit exceedances. In till, the baseline data set should account for this situation.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. As noted in the Comment Response #7, DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations.

Action: Refer to Action #7.

13. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-8 Line #: 1 Code: C
Original Comment #: 13

Comment: DOE should provide the control chart for Cell 3 total uranium concentrations in the LDS to allow verification of the discussion of the LDS trends provided in this paragraph.

Response: As identified on page A.5-7 (lines 11-13), there are no control charts for Cell 3 LDS due to insufficient data (it was dry until late 2002). There are enough data (approximately five data points) to perform trend analysis on the overall data set. The referenced trend refers to data provided in Attachment A.5.2 time versus concentration plots.

Action: No action required.

14. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-8 Line #: 22 Code: C
Original Comment #: 14

Comment: A leak concern may exist (Cell 1, boron) based on the downward trend in the concentrations between the monitoring horizons. Concentrations decline from the LCS (maximum baseline is 1.66 mg/L) to the LDS (maximum baseline is 0.27 mg/L) to the HTW (maximum baseline is 0.27 mg/L), the HTW cusum shows a strong upward trend, and the standardized mean exceeds its control limit. Pre-existing till contamination is a very questionable explanation for the HTW control limit exceedances.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. As noted in the Comment Response #7, DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations.

Action: Refer to Action #7.

15. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-8 Line #: 32 Code: C
Original Comment #: 15

Comment: A leak concern may exist (Cell 2, boron) based on the downward trend in the concentrations between the monitoring horizons. Concentrations decline from the LCS (maximum baseline is 2.24 mg/L) to the LDS (maximum baseline is 0.43 mg/L) to the HTW (maximum baseline is 0.067 mg/L), and the HTW cusum shows a strong upward trend. The standardized mean does not yet exceed its limit but the trend is upward. Pre-existing till contamination is a very questionable explanation for the observed trends.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. As noted in the Comment Response #7, DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations.

Action: Refer to Action #7.

16. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-8 Line #: 38 Code: C
Original Comment #: 16

Comment: DOE should provide the boron control chart for Cell 3 to allow verification of the LDS trends discussion provided in this text.

Response: Refer to Comment Response #13.

Action: No action required.

17. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: A.5 Pg #: A.5-9 Line #: 33 Code: C
Original Comment #: 17

Comment: A leak concern may exist (Cell 1, total organic halogens) based on the downward trend in the concentrations between the monitoring horizons. Concentrations decline from the LCS (maximum baseline is 0.635 mg/L) to the LDS (maximum baseline is 0.0971 mg/L) to the HTW (maximum baseline is 0.0124 mg/L), the HTW cusum shows an upward trend, and the standardized mean exceeds its control limit.

Response: DOE acknowledges the comment. As identified in Comment Response #3, the intent of providing control charts was as a means of providing additional information to establish an evaluation protocol for leak detection monitoring and as a means of addressing Ohio Administrative Codes. As noted in the Comment Response #7, DOE agrees that the control limits established in the control charts are not appropriate for use in early warning leak detection determinations.

Action: See action for Comment #7.

18. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: Attachment A.5.1 Pg #: Control Charts A.5-9 Line #: NA Code: C
Original Comment #: 18

Comment: Please clarify the meaning of the Footnote (a) appearing on the LDS and LCS control charts that states, "Baseline is associated with HTW and GMA locations."

Response: As identified in the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan, the establishment of baseline conditions is associated with groundwater (i.e., perched water [horizontal till wells] and Great Miami Aquifer) not the LCS or LDS. The footnote was trying to allude to this fact and was a means of identifying that the baseline period provided on the chart was in reference to the groundwater horizons. Control charts of the LCS and LDS have been provided as supplemental information.

Action: No action required.

19. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: Attachment A.5.1 Pg #: Control Charts A.5-9 Line #: NA Code: C
Original Comment #: 19

Comment: Please provide an example t-test and F-test calculations showing the baseline and post-baseline source data sets and the null and alternative hypotheses used.

Response: Example calculations are provided in Enclosure 1.

Action: No action required. Please refer to Enclosure 1.

20. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: Attachment A.5.2 Pg #: Conc. Plots Line #: NA Code: C
Original Comment #: 20

Comment: Please clarify why the baseline and post-baseline intervals shown on the concentration versus time plots differ from those shown on the control charts.

Response: The baseline interval on the Attachment A.5.2 plots represents the initial baseline period. The baseline interval on these plots does not always correspond to the baseline period identified on the Attachment A.5.1 control charts because, based on the t-test and F-test calculations, it was concluded that some baseline periods could be extended through 2003. The plots in A.5.2 will continue to be presented; however, references to baseline and post-baseline intervals will be removed to avoid confusion.

Action: The plots in A.5.2 will continue to be presented; however, references to baseline and post-baseline intervals will be removed to avoid confusion.

21. Commenting Organization: Ohio EPA Commenter: GeoTrans, Inc.
Section #: Attachment B.1 Pg #: Line #: NA Code: C
Original Comment #: 21

Comment: Please include how many times the SWRB overflowed (B.1.1.2) and how many times the SWM pond (B.1.3) was pumped out in this section.

Response: The Storm Water Retention Basin overflowed once during 2003, specifically on June 15 with approximately 835,000 gallons of storm water having overflowed to Paddys Run. The SWM Pond was discharged twice to Paddys Run during 2003 because the pre-discharge uranium results were less than 30 μg/L. The specific dates were on March 19 and April 21, with approximately 736,000 and 590,000 gallons pumped, respectively.

Action: In future annual site environmental reports, Appendix B will include the number of overflows and the number of times the SWM Pond was pumped out and discharged to Paddys Run via the Pilot Plant Drainage Ditch.

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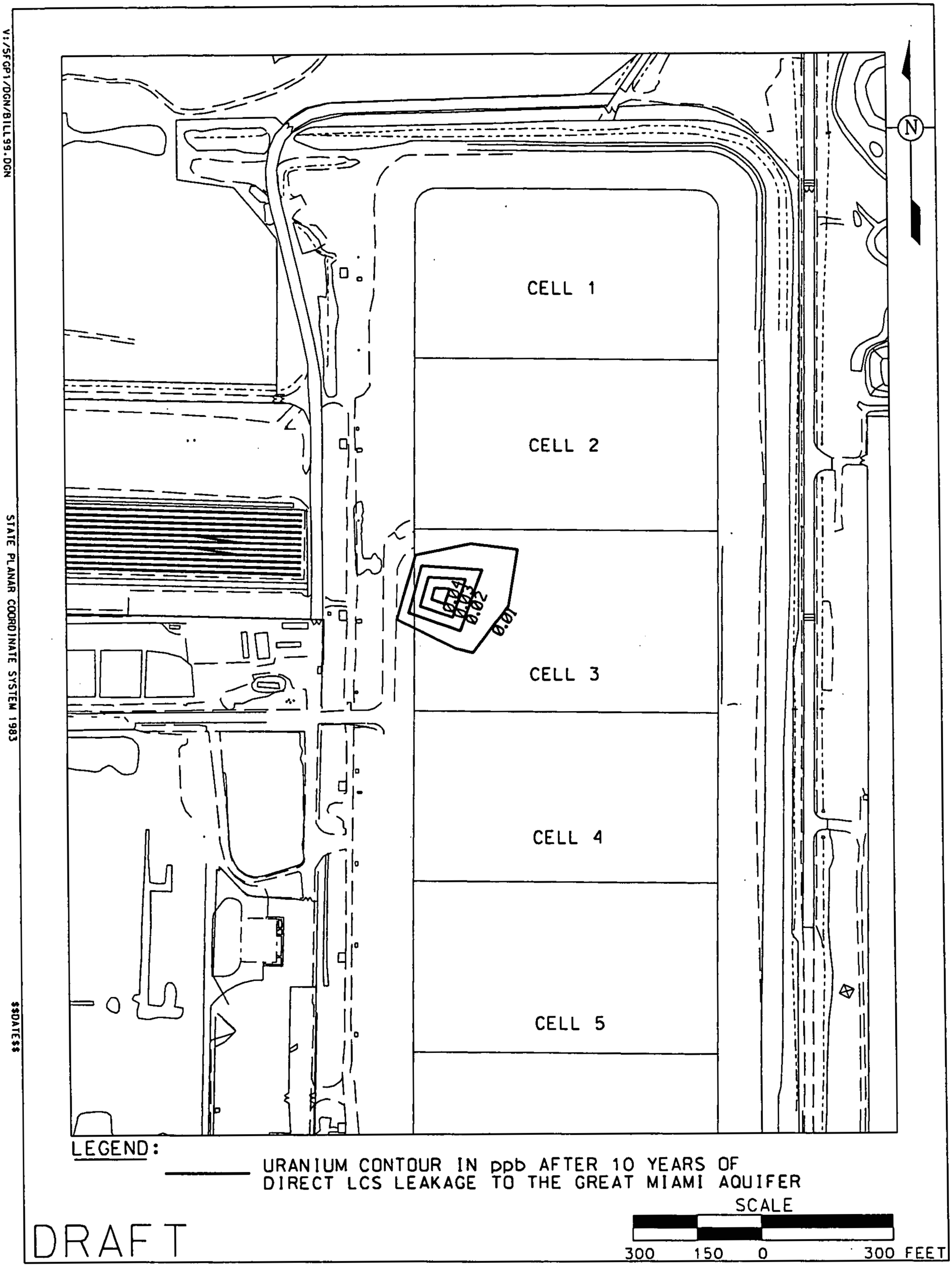

MODELING RESULTS IN SUPPORT OF RESPONSE TO COMMENT #7

Enclosure 1

Example *F*-Test and *t*-Test Calculations

***F*-Test**

The F-Test is used to compare the variance of two datasets to determine if the database distributions are similar in dispersion. It would be expected that similar datasets would have similar distributions and the F-Test is designed to test for equality of variances. The test statistic, F, is the ratio of one variance to another. This ratio is then compared to the known probabilities of the F-distribution.

$$F = \frac{S_1^{\ 2}}{S_2^{\ 2}}$$

where $S_1^{\ 2}$ is the sample variance of the first dataset and $S_2^{\ 2}$ is the sample variance the second dataset. The equations for the sample variances are:

$$S_1^{\ 2} = \frac{\sum\left(X_{1i} - \overline{X}_1\right)^2}{N_1 - 1} \text{ and } S_2^{\ 2} = \frac{\sum\left(X_{2i} - \overline{X}_2\right)^2}{N_2 - 1}$$

where S_j^2 can be rewritten as

$$S_j^{\ 2} = \frac{\sum X_{ji}^{\ 2} - \left[\left(\sum X_{ji}\right)^2 / N_j\right]}{N_j - 1}$$

where j=1 for the first dataset and j=2 for the second dataset.

And where X_{ji} = the ith sample from the jth dataset,

N_j = the number of samples in the jth dataset,

$\sum X_{ji}^{\ 2}$ = sum of squares in jth dataset,

$\sum X_{ji}$ = sum of observations in jth dataset, and

$\overline{X}_j = \frac{\sum X_{ji}}{N_j}$ = the sample mean of the jth dataset.

The critical region consists of values of $F < F_{\frac{\alpha}{2}}\left(N_1 - 1, N_2 - 1\right)$ or $F > F_{1-\frac{\alpha}{2}}\left(N_1 - 1, N_2 - 1\right)$.

t-Test

The *t*-Test is a statistical test used to assess the equality of means of two datasets. The test has two computational variants: one for unequal variances and one for equal variances. In the case of equal variances the overall or "pooled" variance is used in the calculations of the *t*-statistic and the subsequent probability value (*p*-Value).

If the sample variance of the first dataset, S_1^2, is equal to the sample variance of the second dataset, S_2^2, then the pooled sample variance, S_p^2, is used in the calculation of the *t*-statistic. Note that "equality" of variances is determined by the results of the *F*-Test as illustrated above.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S_p\sqrt{(1/N_1)+(1/N_2)}}$$

where S_p^2 is the pooled mean-square estimate of σ_p^2 (the pooled variance) given by

$$S_p^2 = \frac{\sum X_{1i}^2 - \left[\left(\sum X_{1i}\right)^2/N_1\right] + \sum X_{2i}^2 - \left[\left(\sum X_{2i}\right)^2/N_2\right]}{N_1+N_2-2}$$

$$S_p^2 = \frac{(N_1-1)S_1^2+(N_2-1)S_2^2}{N_1+N_2-2}$$

$S_p = \sqrt{S_p^2}$ (the pooled sample standard deviation).

The degrees of freedom, $df = (N_1 + N_2 - 2)$.

If the sample variance of the first dataset, S_1^2, is not equal to the sample variance of the second dataset, S_2^2, then the equation for the *t*-statistic is as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{(S_1^2/N_1)+(S_2^2/N_2)}},$$

and the degrees of freedom, $df = \dfrac{\left[\left(S_1^2/N_1\right)+\left(S_2^2/N_2\right)\right]^2}{\dfrac{\left(S_1^2/N_1\right)^2}{N_1}+\dfrac{\left(S_2^2/N_2\right)^2}{N_2}}$.

The critical region for the *t*-Test consists of values of $t < t_{\frac{\alpha}{2}}(df)$ or $t > t_{1-\frac{\alpha}{2}}(df)$.

Please note that the degrees of freedom for the unpooled sample variance scenario will not be an integer so interpolation of the *t*-Tables will be required. For increased accuracy, the calculations of the *p*-Values for the *t*-Test (both pooled and unpooled situations) in the Sitewide Environmental Report were performed using the Statgraphics statistical software package.

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Example Calculations: Well 22200 – Total Uranium

Quarter	Result	Qual	Calculation Value (X_{yi})	X_{yi}^2
1997-Q2	1.11	-	1.11	1.2321
1997-Q3	0.288	-	0.288	0.082944
1997-Q4	0.222	-	0.222	0.049284
1998-Q1	0.0	U	0.0	0.0
1998-Q2	0.206	-	0.206	0.042436
1998-Q3	0.049	-	0.049	0.002401
1998-Q4	0.15	-	0.15	0.0225
1999-Q1	0.071	U	0.0355	0.00126025
1999-Q2	0.13	-	0.13	0.0169
1999-Q3	0.193	U	0.0965	0.00931225
1999-Q4	0.112	U	0.056	0.003136
2000-Q1	0.3676	-	0.3676	0.13512976
2000-Q2	0.113	U	0.0565	0.00319225
2000-Q3	0.991	-	0.991	0.982081
2000-Q4	0.232	-	0.232	0.053824
2001-Q1	0.124	U	0.062	0.003844
2001-Q2	0.874	U	0.437	0.190969
2001-Q3	0.17	U	0.085	0.007225
2001-Q4	0.287	-	0.287	0.082369
2002-Q1	0.303	-	0.303	0.091809
2002-Q2	0.11	U	0.055	0.003025
2002-Q3	0.878	-	0.878	0.770884
2002-Q4	0.348	-	0.348	0.121104
2003-Q1	1.03	-	1.03	1.0609
2003-Q2	0.0912	U	0.0456	0.00207936
2003-Q3	0.285	-	0.285	0.081225
2003-Q4	0.0	U	0.0	0.0

Initial Baseline Period: 1997-Q2 through 2000-Q4
Potential Update Period: 2001-Q1 through 2002-Q4

Let X_{1i} be the i^{th} result from the Initial Baseline Period and let X_{2i} be the i^{th} result from the Update Period.

F-Test sample calculation

$$N_1 = 15$$
$$N_2 = 8$$
$$\sum X_{1i} = 3.9901$$
$$\sum X_{2i} = 2.107$$
$$\sum X_{1i}^2 = 2.6365$$
$$\sum X_{2i}^2 = 1.1501$$

$$S_1^2 = \frac{\sum X_{1i}^2 - \left[\left(\sum X_{1i}\right)^2 / N_1\right]}{N_1 - 1}$$
$$S_1^2 = \frac{2.6365 - \left[(3.9901)^2 / 15\right]}{15 - 1}$$
$$S_1^2 = 0.1125$$

$$S_2^2 = \frac{\sum X_{2i}^2 - \left[\left(\sum X_{2i}\right)^2 / N_2\right]}{N_2 - 1}$$
$$S_2^2 = \frac{1.2712 - \left[(2.4550)^2 / 8\right]}{8 - 1}$$
$$S_2^2 = 0.0752$$

$$F = \frac{S_1^2}{S_2^2} = \frac{0.1125}{0.0752} = 1.4962$$

The *p*-Value of the *F*-Test ratio = 0.5926.

Since the *p*-Value of the *F*-Test is greater than 0.05 we would conclude that there is insufficient evidence that the variances are not equal and, therefore, assume that they are equal.

Please note that using a statistical software package such as Statgraphics (Manugistics) or Systat (SPSS) or a spreadsheet package such as Excel (Microsoft), the probability from the F-distribution can be determined with greater accuracy than from published tables which are concerned more with critical values. The probability values presented in the 2003 Sitewide Environmental Report were determined using Statgraphics. Also, please note that for this example calculation the numerical values are presented as rounded to four decimal points. This rounding can effect the calculations. The actual calculations were performed using Excel without rounding so that the accuracy would not be compromised.

t-Test sample calculation

Continuing with the same example we use the *t*-Test for pooled sample variance since we concluded that the sample variances were equal. Using the results of the calculations shown above we calculated the pooled sample variance:

$$S_p^{\ 2} = \frac{(N_1 - 1)S_1^{\ 2} + (N_2 - 1)S_2^{\ 2}}{N_1 + N_2 - 2}$$

$$S_p^{\ 2} = \frac{(15-1)0.1125 + (8-1)0.0752}{15+8-2}$$

$$S_p^{\ 2} = 0.1001$$

$$S_p = 0.3163$$

The *t*-statistic is then calculated:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S_p\sqrt{(1/N_1) + (1/N_2)}},$$

where

$$\overline{X}_1 = \frac{\sum X_{1i}}{N_1} = \frac{3.9901}{15} = 0.2660\text{, and}$$

$$\overline{X}_2 = \frac{\sum X_{2i}}{N_2} = \frac{2.4450}{8} = 0.3069.$$

Calculating *t*:

$$t = \frac{0.2260 - 0.3069}{0.3163\sqrt{(1/15) + (1/8)}} = -0.2957$$

Using Statgraphics (or Excel) the associated *p*-Value is 0.7704. Since the *p*-Value is greater than 0.05 we conclude that there is insufficient evidence to reject the hypothesis that the means are different.

Final Conclusion Based on the *F*-Test and *t*-Test Results

Since the sample variances and the sample means can not be shown to be different, we determine that the datasets are similar and can be combined.